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Don Rotolo, N2IRZ

Most folks consider the Internet to be synonymous with the World Wide Web, when in fact Internet is merely the 'pipeline' that carries the data from "HTTP" (web) servers to the end user. Although setting up a web server on the Internet is no big feat, how about using a different pipeline, one accessible only to Hams, with virtually unlimited access speeds possible? Yes, Packet Radio. We Amateurs have gobs of high-quality radio spectrum, and increasingly sophisticated RF gear, available to implement a data pipeline that can rival any wired connection.

This month in Computers and Internet, we'll see just how Packet radio can be used to carry HTTP data. Andy Nemec, KB9ALN, has updated and re-written an article that appeared in the February 1999 issue of CQ-VHF. Drop that old notion of Packet being 1200 baud and text-based: With some of the new European radios and modems rated at 76 kilobaud, we have the means to beat those puny 56 kb phone modems today. In the not-too-distant future, the TAPR Spread Spectrum Radios, with their potential 'over 500 kb' data rates, will blow wired connections out of the water. Hold onto your hats, 'cause here we go over to Andy...

Web Pages on Packet Radio: The Basics

Before we discuss how to set up a Web service, it is important to understand the Client/Server concept. A client is a computer running software designed to collect and display (or store) information provided by the server. When you connect to the Internet and view web pages, your computer uses a Web browser as the Client software. A Server is a computer running a specific program that allows it to provide a service on behalf of a user or another computer. In the World Wide Web, a computer that stores and dispenses copies of web pages is known as a "Web Server".

To use a familiar example, a Packet BBS is an example of a Server, and a user reading bulletins from that server is using a Client computer.

So, to deliver Web pages, we need a server to store and distribute the web pages on demand, suitable client software to interpret and display the pages, and a network to deliver them. The network can be Radio-based just as easily as wire-based.

Network Interconnection

Packet radio uses the AX.25 protocol as the standardized method that our computers use to communicate with each other. TCP/IP, Net/Rom, and other protocols can be sent via packet radio, but they must first be "wrapped-up", or "encapsulated" into an AX.25 packet. Especially interesting is TCP/IP encapsulation, because this is the native language of the Internet. Once we have the ability to send TCP/IP packets, we then need the ability to carry the packets to their

destination: This is where the radio network comes into play. When all of these pieces (server, radio interface, and radio network) are put together, we have something that looks like Figure 1.

Specifics of Our Setup

The Server uses Linux as an operating system on an older 33 MHz 486 computer. For those who may be unfamiliar with Linux, it is a multi-tasking operating system that is gaining wide popularity these days. Because of it's multi-tasking nature, it is able to run the two programs necessary to serve up those fresh Web pages.

The program that actually talks to the TNC and provides radio service (such as a BBS and other conventional packet functions) is *JNOS*. This software, a flavor of KA9Q's famous NOS, is coupled to Linux as though it were a separate computer through a pretend Serial Line Internet Protocol (SLIP) pathway called a UNIX "pipe". The actual web-server software is *Apache*, a very popular and well-used Internet Web-server program. It listens for incoming Web page requests and serves them up to the radio network, using JNOS as a gateway to the radio network. It is worthy of note that JNOS has a web server built into it, too.

You may be asking why we are using a separate program for Web service when JNOS has a server built-in? This is simple - capabilities. It is possible to put Apache on an entirely different computer and link it to JNOS through a wired network (which our first trial did). This would allow even more services and computers linked to the radio network. And Apache has some enhanced security features, as well as enhanced capabilities that make it appealing for our use.

JNOS talks to a TNC running KISS at a radio speed of 9600 bps. This TNC talks to a radio network through a 9600 bps LAN node, which is in turn linked to a 9600 bps Backbone node and 1200 bps LAN node.

The client side is somewhat similar to the server side in that it also uses JNOS running on Linux. Of course, we don't need Apache - this is a "client only" computer. Instead, we use one of the client browser software packages such as Lynx, Netscape, Arena or Opera, to name a few. *(Internet Explorer is not available for Linux - Ed.)*. Again, we are using JNOS to talk to the 9600 bps KISS TNC.

The Web Pages themselves are written in HTML, the language of the Web. They are simple text in content, with no graphics, to maintain reasonable performance at 9600 bps. The system operates just as you might be accustomed to - it supports linking to other pages and other sites. Our server was not set up to link to other sites, but there is no reason why it could not be configured to do so. In fact, any legal application supported on the Internet World Wide Web can be used on the radio network.

Graphics and other data can be sent as well, but it was decided that the heavy download time needed would not be suitable for a radio path that is shared with others. However, a Web page

with mostly text content goes fairly fast at 9600 bps if the radio network is not too busy.

Are There Other Ways To Do This?

Linux is the best choice for a server operating system, as it is born to do server work. Setting up a DOS-based server would be very difficult, and probably limit it's utility - assuming you could find something that can run effectively under DOS. Clever people probably can use Windows NT as a server, but I don't like it, so I chose Linux.

The client side is a little more flexible, however. There are two methods to do this, one is through the addition of a software program. The other uses a special, new version of a TNC.

The software solution consists of two programs that have been written to allow Windows computers operating their TCP/IP systems with a TNC. They are called ETHRAX25, and there are two versions available. One is for Windows 3.x and the other for Windows 95/98. What these programs do is wrap the TCP/IP packets from your browser into AX.25 packets, and send them to your TNC through your serial port. Both these programs are available on the World-Wide-Web - see the resources section at the end of this article for the URL. This would allow the use of Internet Explorer and other Microsoft resources.

You will need a TCP/IP address in order to use this system, which is free for the asking from your local or state IP address coordinator. See Resources, below.

One possible hardware solution involves the MCB-152 TNC that was developed by a group of European hams. This microcontroller-based TNC is unique in that it *behaves like a telephone modem*, ready for your favorite browser software to use. The disadvantage is that you have to buy another piece of hardware. The big advantage is that you don't have to set up any special software. If you have more money than time, then the MCB-152 might be for you. Information on the MCB-152 is provided in the resources section at the end of this article.

Web Servers

If you prefer to run the built-in WWW server in JNOS, it is not hard to set up and it does allow you to control all of your facilities with one program.

Apache operating as a separate program was used for a few reasons. One is that at some point, the web server software may be moved to another computer on my home Ethernet. Another is flexibility - we can upgrade
server software without changing the JNOS packet radio software, and vice-versa. Apache also supports a lot more of the newer Web plug-ins and it will doubtless support newer Web applications faster than JNOS can support them. Yet another reason is that at some point we hope to implement Dynamic Host Control Protocol (DHCP), which assigns a temporary IP address to those who don't have a permanent one. Linux handles this, but JNOS does not right now. For

most applications, configuring the JNOS WWW server may be all you need, however.

The Future:

As I mentioned above, we plan to implement DHCP at some point in the future. In addition, we have already invited users to put their own web pages on the server, and at least one local ham has. Eventually, the plan is to make the BBS and Web server part of an Amateur Radio "Internet Service Providing Host" for the Green Bay and Northeastern Wisconsin area.

Another future plan doesn't involve software, clients, servers, or other such things. It is our network infrastructure - we will be converting, on a trial basis, to 19.2 Kbps radio speed. The hope is that we can convert our backbone to operate at this speed, possibly providing faster service to more of the state's networked TCP/IP host computers
that live on packet radio. Other ideas revolve around TAPR's Spread Spectrum radios, with their Faster-than-ISDN speeds.

In Closing:

This was an especially fun project that I recommend to technically-minded packeteers for duplication. I also recommend a good radio network for the task, and at least 9600 bps speed. It also is especially important to
consider the content and size of the web pages, and the time of day you decide to test. Other users of the packet radio network in your area will be glad you did.

Special thanks to Linus Torvalds, the many Linux contributors, the Apache team, James Dugal, N5KNX for carrying on the work on the JNOS program, Steve Mc Donough, KE9LZ and finally, to Ron Nelson, N9CFN for all of their good work in making this possible. I welcome your questions and comments on this. If you do decide to undertake this project, good luck and 73, Andy KB9ALN.

Next time in Computers and Internet, we'll take a look at some interesting and unusual ways of using the World Wide Web and other Internet resources to not only *enhance* Amateur Radio operating, but to *actually operate*... Until then, 73 de N2IRZ.

Resources:

Apache Web Server Software: User guides and downloadables are available from the source at <http://www.apache.org>.

ETHRAX25 Software: A great how-to guide written by Mark Frey, VE3DTE, can be found at <http://www.ampr.torun.pl/packet/howto95.html>. The ETHRAX25 software itself is available from Gary Grebus, K8LT's web site at <http://www.mv.com/users/grebus/>.

JNOS Software: A good source for the latest JNOS software is the Tucson Amateur Packet Radio web site: <http://www.tapr.org>. Follow the "software" link to the "TCP/IP" area, and select the latest version of JNOS. If you aren't already a member, the annual dues of $20 are a bargain. Tucson Amateur Packet Radio, 8987-309 E. Tanque Verde Rd. #337, Tucson AZ 85749-9399, USA. Phone: 940-383-0000, Fax: 940-566-2544, E-Mail: tapr@tapr.org

TCP/IP Coordinators: An up-to-date listing of local IP address coordinators is maintained at: <ftp://ftp.ucsd.edu/hamradio/amprnets>. Contact the one in your area for an IP address assignment.

The MCB-152 Project: Information on the European MCB-152 project, which is a microcontroller board that interfaces with a variety of radio modems (including some very high speed modems), is available at <http://www.caseconsole.com/mcb152/>. Scroll down a little to the Packet Radio project.

Some background information on this project is available at the Wisconsin Amateur Packet Radio web site: <http://netnet.net/~ke9lz>. Especially interesting is the “Using the Wisconsin Network” series, parts 10, 23, 24 and 40. Contact Info: Wisconsin Amateur Packet Radio Association, c/o Bob Gedemer, KA9JAC, 609 Wilson St., Neenah WI 54956. Membership is $20/year, or $15 without the "Badger State Smoke Signals" subscription, a combined newsletter for many area Ham clubs. Write for details.

Contact the author, Andy Nemec, KB9ALN, 453 Cottage Grove Ave., Green Bay WI 54304. E-Mail <kb9aln@juno.com>.

Captions:

Figure 1: An overview of the setups for the server and client side computers. The node site runs standard TheNET firmware, but most any networking system will work just fine. We presently use 9k6 radio channels, and hope to upgrade to 19k2 to improve performance.